# ORIGEN User Manual

**Revision: r0p1**

## Linux User Guide

ORIGEN BOARD.ORG

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**ORIGEN Development Kit**

## ORIGEN User Manual

## Linux User Guide

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**Release Information**

**Change History**

| Data | Issue | Change |
|---|---|---|
| **july2011** | **A** | **First Release for r0p1** |
| | | |
| | | |

# Chapter 1

## Precognition details

**Plesecheck this article before you operated ORIGEN Type-A board.**

**This article consisit of threesections like below. :**

- **Precognition detail**
- **Product Introduction**
- **Product specifications**

# 1. Precognition detail

This article describe precognition details before user operate the ORIGEN.

## 1.1. Definition of basic term

This user manual contains various terms. We try to use standard term.
We define some of terms by ourselves which are related product.

- **Description of terms**

| | |
|---|---|
| ORIGEN<br>(Ori: en) | Embeded development solution equipment basd on Samsung Exynos4 SoC.This equipment contains usuful programs lkie GNU tool chain,bootloader, Embeded Linux, Device Driver,Google android platforms etc. |
| Host Systme | Host System provides install applied programs and build development environment. We recommend use uBunto 10.10 For Linux & android platform applied program development in the ORIGEN. |
| Target System | System for execute made from Host System.<br>In this user manual, The target system is The ORIGEN. |
| Development Board | ORIGENor Same as Target System. |
| Embdded Linux | Linux for Embedded System &small system. |
| EXYNOS4(S5PV310) | EXYNOS4 (S5PV310) issingle Coreporcesser interrelated ARMv7 Cortex-A8 made in Samsung.Co.,Ltd. 본 사용자 설명서는 이하 EXYNOS4(S5PV310)으로 용어를 통일하여 기술 합니다. |
| BSP | BSP (Board Support Package) is OS for Platform Board & applied program package. |


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## 1.2. Additory information

ORIGEN is platform for low coast development environment based onARM Cortex-A9Dual.
You can get technical questions &informations on the below Websites when the ORIGEN use.

| Title | Contents | |
|---|---|---|
| ORIGEN | | http://www.origenboard.org |
| Exynos4 Processor | Samsung | http://www.samsung.com |
| ARM | ARM | http://www.arm.com |
| GNU Tool | Free Software Foundation | http://www.gnu.org |
| ARM Linux | ARM Embedded Linux<br>aESOP Embedded Forum | http://www.arm.linux.org.uk<br>http://www.aesop.or.kr |
| U-Boot | U-Boot Project<br>aESOP Embedded Forum | http://www.denx.de<br>http://www.aesop.or.kr |
| BSP | ORIGEN,<br>Board Support Package | http://www.aesop.or.kr |


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## 1.3. Board specifications

ORIGEN's developmentenvironment & Hardware specifications.

### 1.3.1. Board development environment

| | | |
|---|---|---|
| **Host System** | O/S Platform | uBuntu Linux 10.10<br>Windows XP SP2/3 |
| | VirtualBox | Sun VirtualBox 2.1.0 or later |
| **Target System** | Platform Board | ORIGEN |
| | Power Supply | 220V DC/5V Input |
| | Serial Cable | Debugingconsol |
| | USB Mini Cable | Boot loader & android applied program downloads. |
| **GNU Tools for ARM** | GNU C/C++ Compiler | arm-none-linux-gnueabi-gcc<br>arm-none-linux-gnueabi-g++ |
| | GNU Assembler &<br>Binary Utilities | arm-none-linux-gnueabi-as<br>arm-none-linux-gnueabi-ar<br>arm-none-linux-gnueabi-nm<br>arm-none-linux-gnueabi-objcopy<br>arm-none-linux-gnueabi-objdump<br>arm-none-linux-gnueabi-ranlib<br>arm-none-linux-gnueabi-ld |


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### 1.3.2. Hardware specifications

| | |
|---|---|
| **Processor** | Samsung Exynos4–1 Ghz<br>(ARMv7 Cortex-A9 dual) |
| **Clock** | 4EA Clock |
| **Memory** | CPU Module<br>- 1Gbytes DDR SDRAM |
| **Display** | 7"1024x600LCD |
| **Camera** | 5M pixel(option) – just tested |
| **Audio** | I2S Audio Interface Support (ALC5625)<br>1 Port Speaker Out (Integrated Speaker)<br>1 Port Headphone Out (Stereo Jack)<br>1 Port Line IN (Stereo Jack)<br>1 Port MIC IN (Stereo Jack)<br>1EA External MIC |
| **UART** | 1 Port RS232 |
| **USB** | 1EA USB Device<br>1EA USB 2.0 Host |
| **Storage** | 2 Port SD/MMC Card Slot |
| **HDMI** | Mini connector |
| **I/O** | 1EA Base boardLED<br>7EA GPIO Button |
| **JTAG** | 1EA 20Pin JTAG Connector |
| **ETC** | Speaker, MICconnector, line in/out connector |
| **Power** | 1EA 5V 2A DC Adaptor |


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### 1.3.3. Software specifications

| | |
|---|---|
| **Firmware** | U-Boot 1.3.4, USB OTG Monitor |
| **System Software** | Bootloader<br>- u-boot 1.3.4<br>Kernel<br>- Linux Kernel 2.6.35.7<br>Compiler<br>- GCC 4.3.1 / GLibc 2.6.1<br>ARM EABI Support Cross Compiler<br>Application<br>- GTK2.0-based X-Windows System(just for boot & test)<br>Google Android Gingerbread |
| **ETC** | User Manual<br>Schematic |


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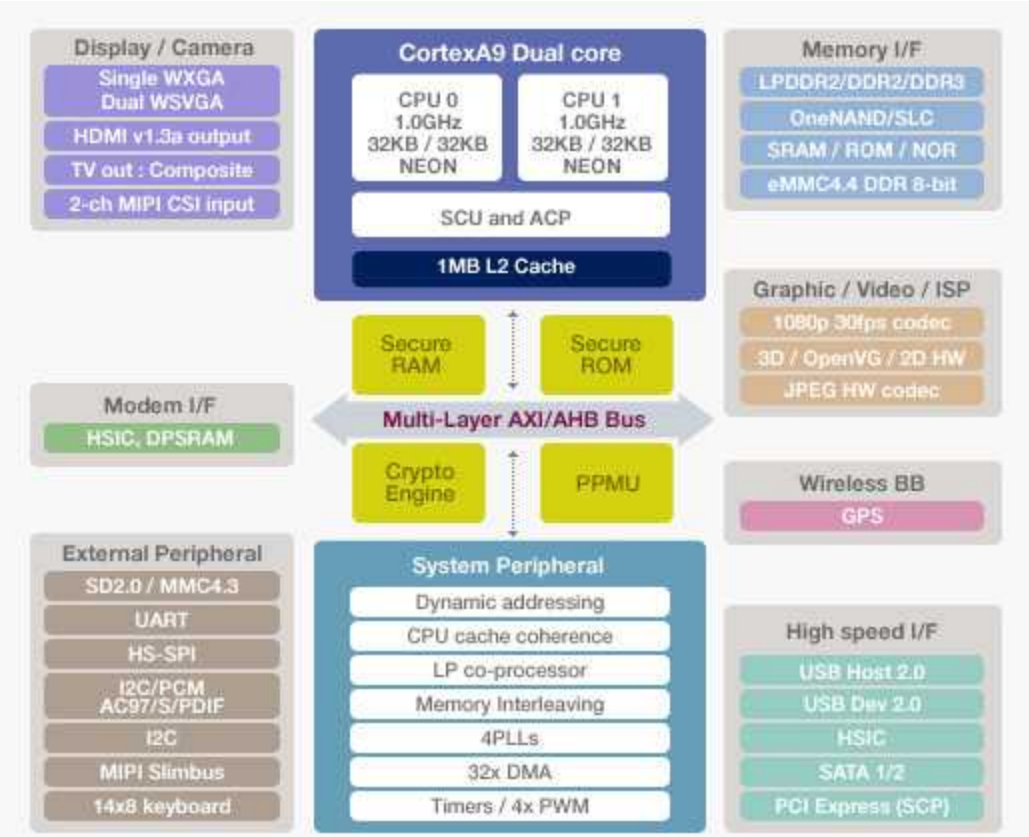
### 1.3.4. EXYNOS4(S5PV310)Block Diagram




※ CPU related term explanation

Orion: Title of Exynos4 series development project, Orion ispopular name of Exynos4 Dualcoreseries

S5PC210: Cortex-A9 Dualcore POP type SoC, Exynos4 + LPDDR2

S5PV310: Cortex-A9 Dualcore Single type SoC, only Exynos4, RAM is outside equip.

Exynos4 series: Orion is project title, S5PC210& S5PV310 impose a new brand name for prevent confuse name.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# Chapter 2

## Prepairing before product install

**This article describes install procedure and build development environment for ORIGEN Board before user operate.**

**This article consisit of five sections like below. :**

- **Target systemspecification**
- **Host System specification**
- **Cable compose**
- **Install Taret System**
- **Configuration of Host Systme& Linux deveolpment**

## 2. Prepairing before product install

Operating for Install procedure is following below purpose.

### 2.1 Target System

Embedded System develops for special optimum purpose like(PMP & Smartphone, DiVX Player, MID etc).Embeded System is one of independent computerSystem. Embedded System contains unique operation system & Device Driver and developed Optimization operation system for management purpose. We define this "Target System" on this article, Also ORIGEN called "Target" system.

ORIGEN will load Embeded Linux, Google Android etc. The users recognize 1) how to record operating System on Target System.2) How to develop applied program and loading. Each CPU model has different specifications so Users also recognize 3) the best development environment for each CPU models.

### 2.2. Host System

Normally weuse only one PC when we develop applied programs & compile. For example, softwaredevelopment is based on Windows XP PC.But Embeded Linux System has difference.
This article purpose is based on development Embeded application. But it is impossible to devvelope use only Embeded System. Because Embeded System do not have enough compiles, application development, large data storage device & memory, operating environment.
So we develop application on Embeded System PC and weexcute established application which finished test by embedded System. We called this system"Cross development environment" and "Host System" has this system (Cross development environment).

Host system must ready cross compiler and terminal program for "Debug port monitering& USB/Serial Cable & Ethernet". Especially Cross complier requirement depends on target board & used processer. We recommend use uBuntu 8.10 or 9.04 or 10.10 versions for Embeded Linux development & Google android application.


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## 2.3. Cable composition

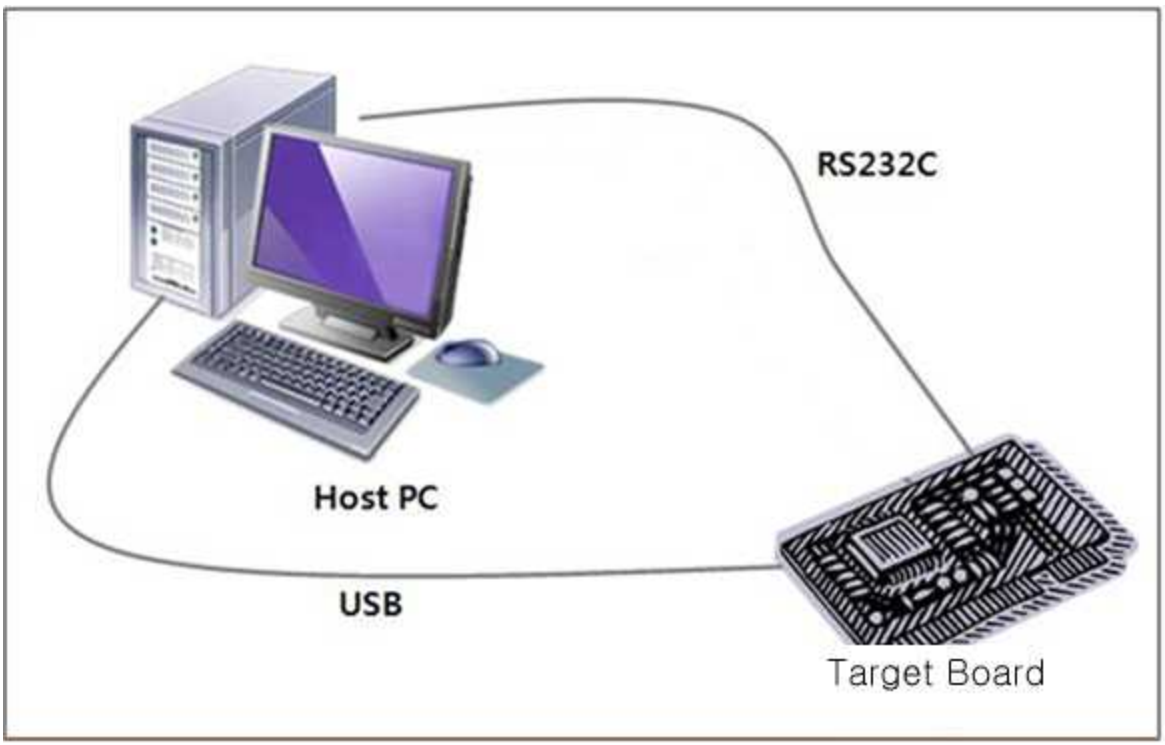
Cable instructions are below (software downloads, Connect between Host system and target system).

LAN : Use Ethernet port for downloads operation Kernel Image.

RS232C : Board operation and Control debugging Consol.

USB Device : Bootloader download, Application download, Debuging etc.

[Picture2-1]Cable Connection between Host system and target system




[Picture 2-1] System connection dirgram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## 2.4. Setting for target system

This article describesserveral setting for CPU module on ORIGEN.

### 2.4.1. Boot mode

Each CPU module has unique boot mode on ORIGEN, Each CPU module setting boot mode are bellow.

**1) ORIGEN CPUmodule boot mode**

ORIGEN CPUmodule supports two boot modes. It can setting by CPU module'sDIP switch.

**① NAND Boot mode (Not supported on Origenboard)**

**② SD/MMC Boot mode(The Basic boot mode on Origen Board)**


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## 2.5. Setting for Host system Linux development

This article describes setting for "**Host system Linux development**"on ORIGEN

※ ***From Origen Board, the environments get little changed for android target. Use Fastboot tool instead of Ethernet development because Windows 7 does not have DNW driver which is supported from Samsung.***

### 2.5.1. Setting for VirtualBoxenvironment Linux development

***※We are strongly recommend use Ubuntu 64-bit for Android Gingerbread development. If you use Ubuntu 32-bit, then some times does not build normally.***

You can get VirtualBox which is manufactured by SUN and Open Source policy.
Please refer to below URL for VirtualBox.

http://www.virtualbox.org/

### 2.5.2. Install & Setting for Development Environment based on Linux.

This manual based on Ubuntu 10.10 installed at Host PC.

1) **Requirement for install environment**

Requirement for install Linux (Host system) environment is bellow.

※ ***Usually Embeded Linux neet network environment but Android development environment does not need network servers.***

- ***Must:The server & package must install.***
- ***Optional:The server & package installed depends on the users.***

▣ **TFTP server(Optional)**

TFTP Server used download Kernel &bootloader Image form ORIGEN's bootloader (U-Boot).


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**▣usb network(Optional)**

Usb network Settings support download Kernel/bootloader& operating RootFileSystemenvironment use NFS whenORIGENBoard Operation.

**▣ NFS Server(Optional)**

NFS Server transmits between Host PC and Embeded Linux System onORIGEN.

**▣Cross Compiler package (Must)**

Cross Compiler package making software package for ORIGEN's Software in Host System.

**▣BootLoader& Kernel Package (Must)**

ORIGENBootloader& Kernel package installed in Host PC, Transmit to ORIGEN use fastbootcommand after compile by Corss compiler.

**2) Install development package (ORIGEN)**

Development package: you can downloadEXYNOS4 (S5PV310) project WIKI page.
X-windowsToolchain:install&unzip inner /opt directory.
Linux kernel Toolchain: install&unzipinner /usr/local/arm directory

3) **Settin Environment parameter for Cross Compiler**

- Linux Kernel&bootloader
  You need environment parameter setting for use Cross Compiler. It is possible just edit "/etc/profile" file at uBuntuLinux.
  Below Command add environment parameter in "/etc/profile" file.

**▣Edit profile**

```
# sudo vim /etc/profile
```


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**▣Edit profile details**

```
/etc/profile: system-wide .profile file for the Bourne shell (sh(1))
# and Bourne compatible shells (bash(1), ksh(1), ash(1), ...).

PATH=$PATH:$HOME/bin:/usr/local/arm/arm-2009q3/bin
export PATH

if [ -d /etc/profile.d ]; then
.....
fi.
```

If you finish the environment setting then apply below command.

**▣Apply edited environment setting**

```
# source /etc/profile
```


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# Chapter 3

## Hardware Composition

**This article describes ORIGEN's CPU module & base board's Hardware composition & specifications which made in AESOP Embedded Forum.**

**The article consists of bellowsections:**

- **CPU module**
  **Product Feature / Specifications / Block Diagram / Major Functions**
- **Base Board**
  **Product Feature / Specifications / Block Diagram / Major Functions**


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# 3. Hardware Operation

Hardware operation parts describe ORIGEN Hardware explain& The Use method & matters that require attention.

## 3.1. ORIGEN Type-A CPU/Base module

ORIGEN CPU module and Base module can reconstruct system.

### 3.1.1. Product Feature

ORIGEN CPU module features in ORIGEN are below.

▣Small CPU module struct board and Easy to changeable & relocation.
▣ Samsung EXYNOS4(S5PV310)–1Ghz
▣ DDR3-SDRAM(1GBytes)
▣ MAX8997 PMIC

ORIGEN Base module features in ORIGEN are below.

▣ USB 2.0 Device, USB 2.0 Host
▣ Provide Multi-ICE debuggingenvironment with 20P JTAG Port
▣ HDMI
▣ UART, Audio Connector
▣ 2 SD Connector
▣50 pin Camera connector(Camera is optional)


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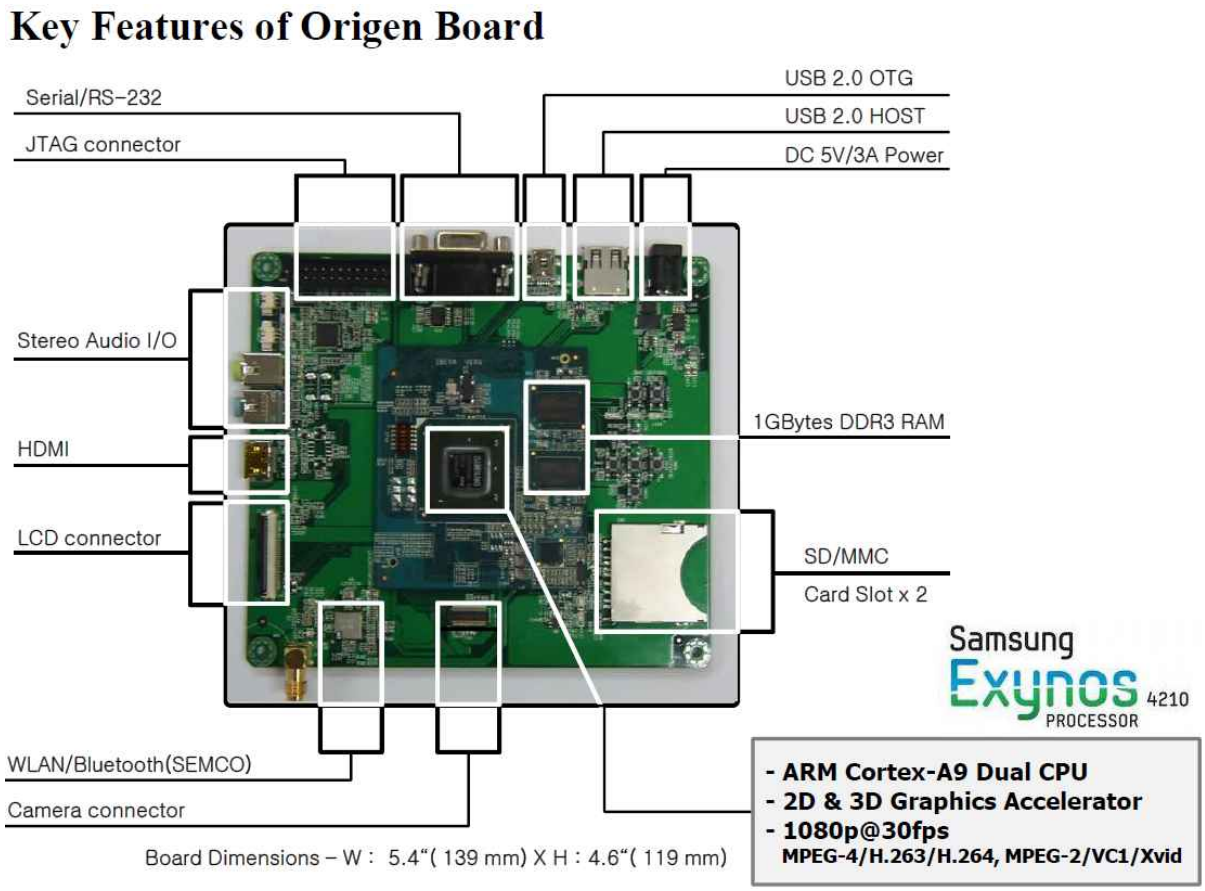
### 1) HardwareBlock Dirgram





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# Chapter 4

## Embedded Linux softwareoperations (ORIGEN)

**This article describes How to install & operating Embeded Linux System to ORIGEN EXYNOS4 (S5PV310) modulewhich made in AESOP Embedded Forum.**

**The article consists of bellowsections:**

- **Preparation before startoperation**
- **Setting Development Environment**
- **U-Boot bootloader build & install**
- **Install & execute the Embedded Linux**


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# 4. Embedded Linux software operation (EXYNOS4(S5PV310))

This chapter describes Embedded Linux environment setting, Complie, Download & booting forORIGENprocesser.

## 4.1. Preparation before start operation

We define that you already finished at"**2.5 Setting for Host system Linux development"**then make process.

## 4.2. Setting for development environment

Setting development environment is very important. If you understand ORIGEN development environment setting then you alse understand other install & environment setting. We use User manual's setting "**2.5 setting for Host system Linux development**".

### 4.2.1. Setting for Host system development environment

Host system environment development purpose & parts are below.

I) Compile operating system & application for Target system.
II) Transfer compiled operating system& application totarget system.
III) Monitering target system's operating condition use Consol port.

This article decribes how to bulid"Development environment Host System & Setting".
Next table is "Current recommendation". You can use your own software or others.

| Type | Current recommandation |
|---|---|
| Host System Processor | Use supported Virtualization Technology |
| Windows Processor | Windows XP SP2 |
| LinuxProcessor | uBuntu Desktop 8.10 |
| Virtual PC S/W | OracleVirtualBox |
| Transfer File &Monitering software | DNW0.6 |

### 4.2.2. Development Environment diagram between Host system and


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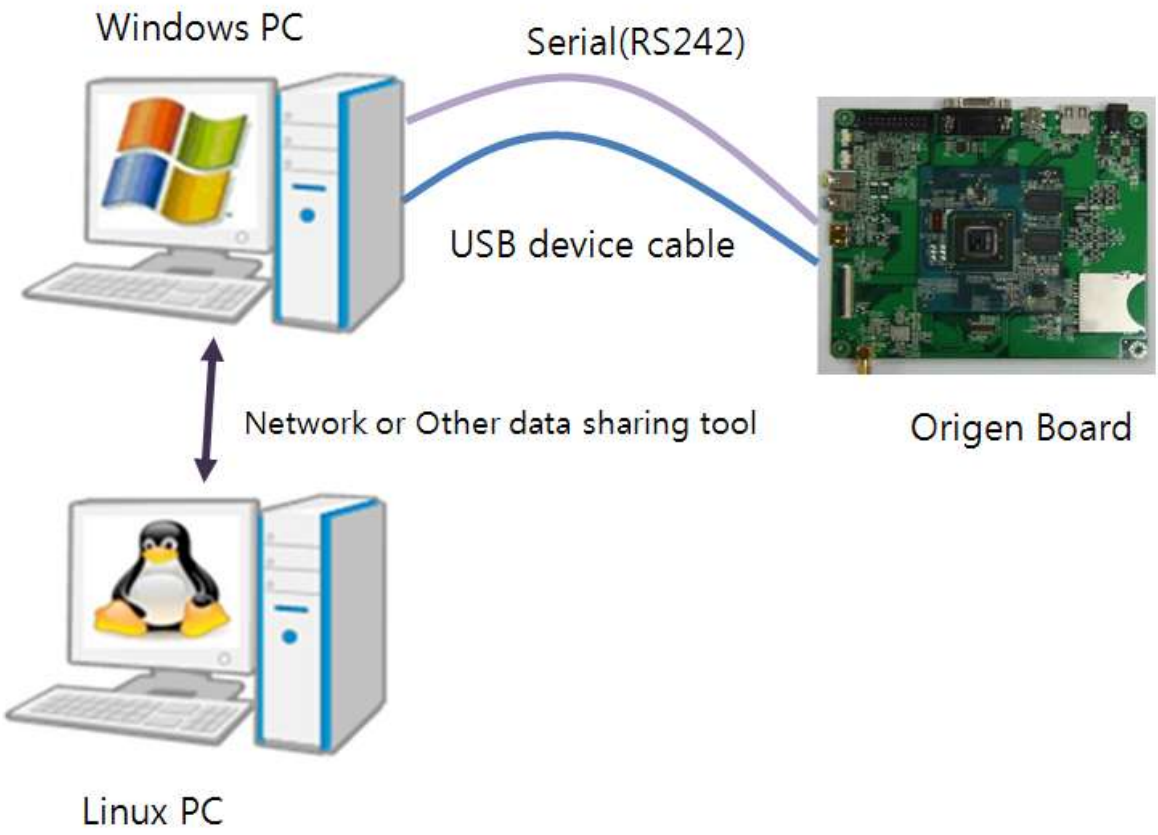
### target system

Connect Serial cable to Windows System for monitering target system operation &transfer bootloader Image.

Connect USB cable to Windows system for Embeded Linux Kernel & Other programs at Linux System.

Use Samba or Virtualbox share folder when you exchange files between Windows system and Embeded Linux system.





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## 4.3. U-Boot bootloader build and install

### 4.3.1. U-Boot summary

Boot loader can make operate Operating System or other programs at particular CPU.
It alse can make operate Basic device like"ROM (or Flash Memory), RAM, UART (Serial port)".

ORIGEN CPU module use U-Boot. This U-Boot normally used at Power PC & ARM based software development. U-Boot is open source project. It normally installed at ROM or Flash memory. It can test & initialize Embeded Board' several Hardware. It can download executable code to Board and performed.

U-Boot development isvery close connection with Linux operating system.
Part of source code can process booting with Linux Kernel executable code by Linux source.
U-Boot structurally easy to move, setting and extend between same types CPU. So It is the standard Embeded systembootloader.

### 4.3.2. U-Boot Build method

U-Boot build is consisting three steps.
First step: Initialized all environmentcompiles.
Second step: Setting environment U-Boot code at the particular CPU Board.
Third step: Makebootloader Inage with before settings.

In this User manual, we use "origen_android_config" which is already finished environment setting at ORIGEN EXYNOS4 (S5V310) CPU module U-Boot Image.

**▣U-Boot build command**

```
# make clobber
# make origen_android_config
# make
```


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If normally build without any errors, then below images are formed

| File name | description |
|---|---|
| u-boot | ELF binary typeU-Boot Image |
| u-boot.map | U-Boot memory batch file |
| u-boot.bin | Plain binary type U-Boot Image |


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### 4.3.3. U-Boot Install method

Install U-Boot ("Embedded Linuxbootloader") in ORIGEN Board for "Embedded Linux booting in ORIGENBoard". Install process are below.

Connect between Host PC's USB Port and target board's usb device cable, because U-Boot transmits with Usb device cable.

Turn on the target board, and thentyping any command beforebootloader goes to timeout (command mode).

Connect Usbmini-cable to between host system and target board, type fastboot command like below.

```
# fastboot
```

Transfer bootloadertyping command like below in Host system.

```
# fastboot flash bootloader /your/working/directory/u-boot.bin
```

Restart and check the changed U-Boot operating.


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## 4.4. Install Embedded Linux &install method

This article describes Linux Kernel Build method
Download & Operating finished Build kernel at target board in ORIGEN
Root file-system use method.

### 4.4.1. Host system environment setting

Build Embedded Linux Kernel refer to "**2.5. Setting for Host system Linux development**".

### 4.4.2. Linux Kernel build method

Build Linux kernel source at ORIGEN is below.

1) Compile and Linux environment setting

Initialize (Clean) before linux environment setting.
Typing below command at Linux Kernel source directory.

```
# make clean
```

Apply"**origen_android_defconfig"**like below.

```
# make origen_android_defconfig
```

Start build Linux kernel.

```
# make zImage
```

2) Download finished build Kernel

If build finished normally, then "zImage" created in "arch/arm/boot directory.

① Turn on ORIGENBoard, and then typing any command. It is command prompt condition.


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```
U-Boot 1.3.4 (Apr 28 2010 - 14:04:19) for aESOP-S5PV210 (Rev.01)


CPU:     S5PV210@1000MHz
        Fclk = 1332MHz, Hclk = 200MHz, Pclk = 66MHz, Serial = PCLK
Board:    aESOP S5PV21-
DRAM:    512 MB
Flash:    0 kB
SD/MMC:   Card not found
NAND:     512 MB
In:       serial
Out:      serial
Err:      serial

aESOP-V210 #
```

② Typing "printenv" on command prompt then you can see now U-Boot environment setting details. Check Ip address & gateway etc.

```
U-Boot 2010.03 (Jul 31 2011 - 01:38:11) for ORIGEN Android

           APLL = 800MHz, MPLL = 800MHz


Checking Boot Mode ...OMPIN : 3
 SDMMC
PMIC:     ARM 1.20V, INT 1.16V, G3D 1.11V

[I2C->ERR] Timeout Slave Address

[I2C->ERR] Timeout Slave Address

[I2C->ERR] Timeout Slave Address
Board:    origen
DRAM:     512 MB
MMC:      host->clock: 400000
host->clock: 50000000
           3827 MB
host->clock: 400000
host->clock: 50000000
*** Warning - using default environment

In:       serial
Out:      serial
Err:      serial

Checking Boot Mode ...OMPIN : 3
 SDMMC
TRUST_ZONE val = 0
TRUST_ZONE val = 32
board_late_init
Hit any key to stop autoboot:   0
ORIGEN #
```


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① Prepare fusing with finished build kernel (below command) in target terminal.

```
ORIGEN #fastboot
```

② Typing below command at Windows cmd(or Linux host), then you can download "The finished build kernel on target kernel"

```
# fastboot flash kernel /your/working/directory/zImage
```

### 4.4.3. Bootloader restore on SD/MMC Card (or u-boot recordon empty SD/MM)

**1) Prepare util by SD/MMC Card & SD Reader & BSP.**

**A. Util : origen_uboot_dump.img origen_uboot_fuse.sh**

**2) Insert SD/MMC Card at SD Reader, Check SD Device at Linux machine.**

```
#>dmesg | tail
```

**3) Write u-boot dump Image for target board with before tested SD Device name in SD/MMC Card.**

```
#> ./origen_uboot_fuse.sh origen_uboot_dump.img /dev/sde
```

**4) Insert SD/MMC on target board.**

**5) Now you can restart the system.**


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# Chapter 5

## Google AndroidSoftware operation (EXYNOS4(S5PV310))

**This article describes How to install & Google Android to ORIGEN EXYNOS4 (S5PV310) CPU modulewhich made in AESOP Embedded Forum**

**The article consists of bellowsections:**

- **Google Android gingerbreadpackage install and Compile. Google Android gingerbreadKernel Compile &Operation.**


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## 5. Google AndroidOperating (EXYNOS4(S5PV310))

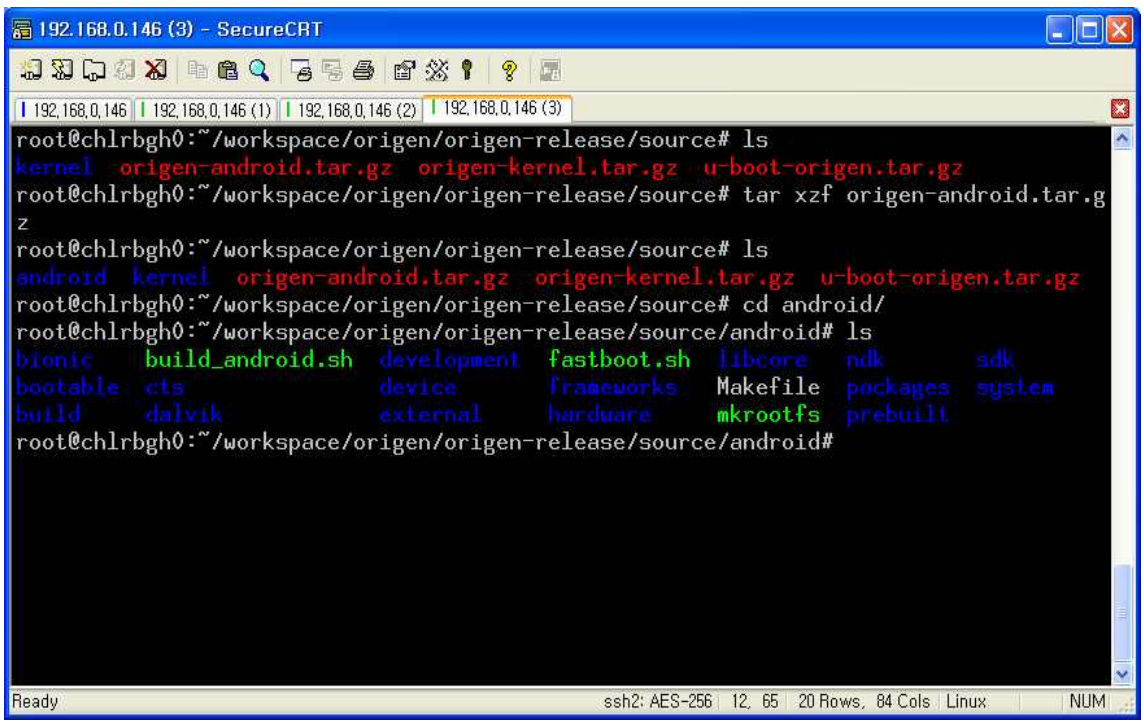
This article decribes install and operation method Google Android system BSP(Board SupportPackage) onORIGEN

### 5.1.1. Google Android GingerbreadPackage install & Compile

Google Android Éclairpackage install & Compile on ORIGEN Board is based on Linux environment.

**① Google Android GingerbreadCompile environment composition**

Unzip "origen-android.tar.gz"on BSP file and compose build environment.




**② Google Android GingerbreadHost package install**

Compose google Android Compile environment in Host system.

Use 'apt-get'Command and install package like below.

```
#>sudo apt-get update
#>sudo apt-get install sun-java6-jdk
```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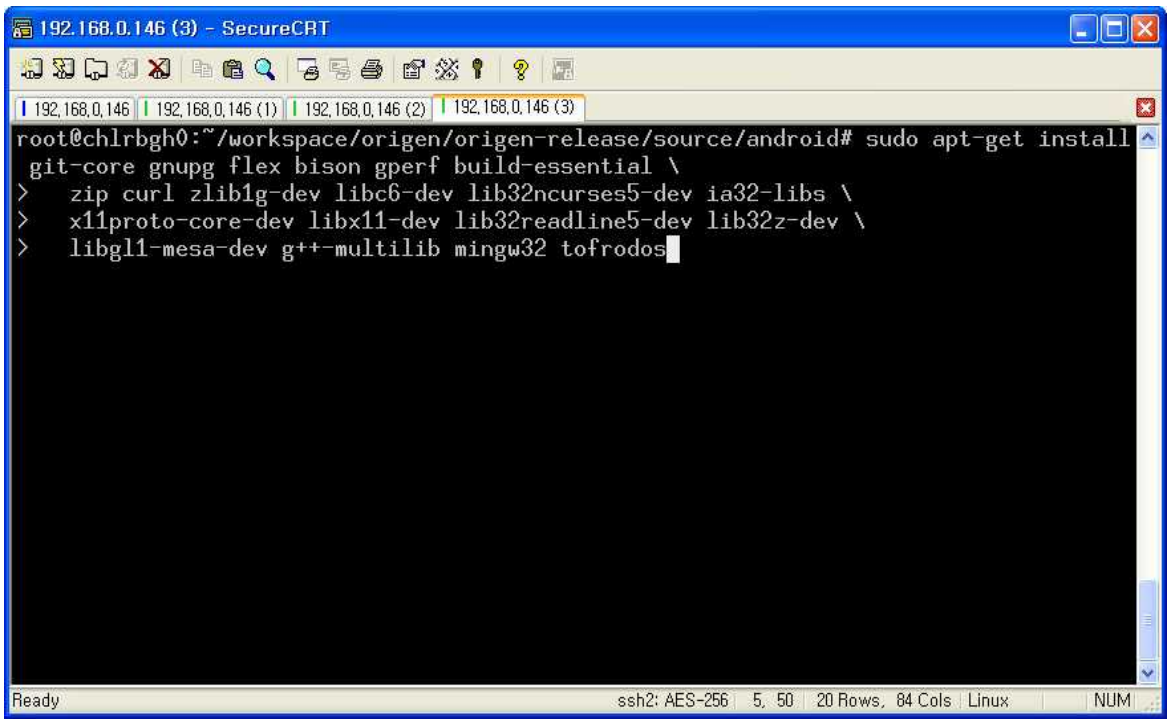
Apt-get package list update & install JDK6.

```
#>sudo apt-get install git-core gnupg flex bison gperf build-essential ₩
  zip curl zlib1g-dev libc6-dev lib32ncurses5-dev ia32-libs ₩
  x11proto-core-dev libx11-dev lib32readline5-dev lib32z-dev ₩
  libgl1-mesa-dev g++-multilib mingw32 tofrodos
```




### ③ Google Android Gingerbread JAVA Default version setting

Google Android Gingerbread support JAVA 1.6 environment.
Setting base java version useinstalled JAVA package.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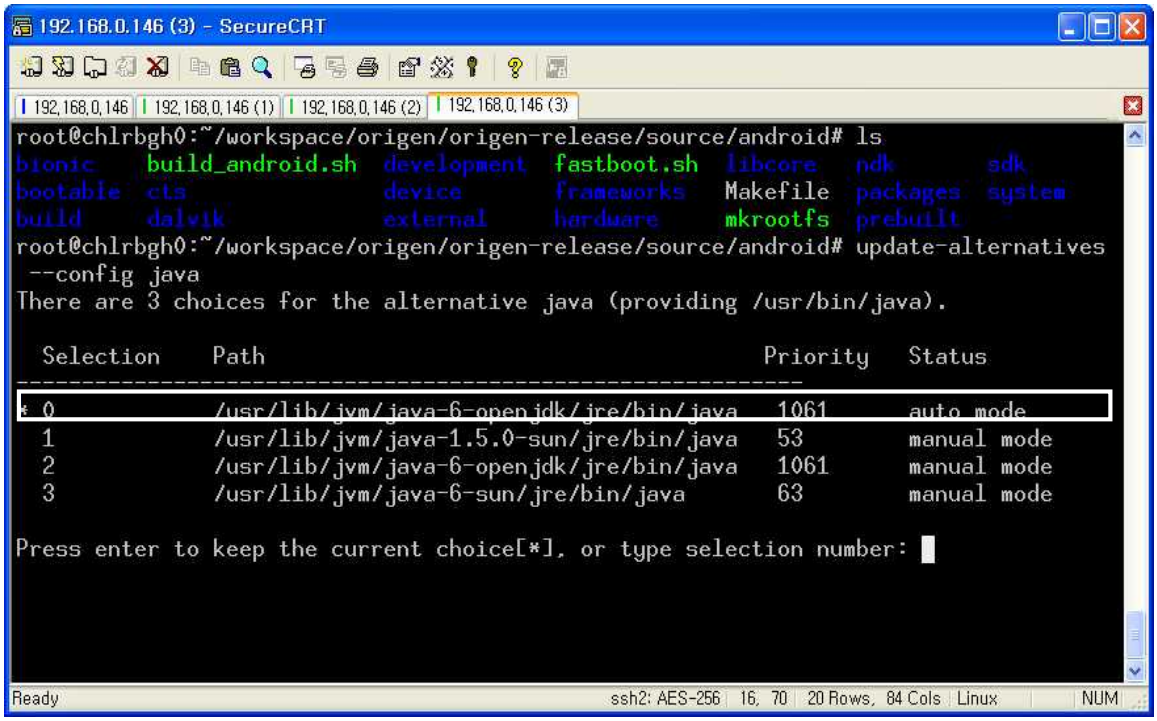
192.168.0.146 (3) - SecureCRT
192.168.0.146
192.168.0.146 (1)
192.168.0.146 (2)
192.168.0.146 (3)
root@chlrbgh0:~/workspace/origen/origen-release/source/android# ls
bionic build_android.sh development fastboot.sh libcore ndk sdk
bootable cts device frameworks Makefile packages system
build dalvik external hardware mkrootfs prebuilt
root@chlrbgh0:~/workspace/origen/origen-release/source/android# update-alternatives
--config java
There are 3 choices for the alternative java (providing /usr/bin/java).
Selection Path Priority Status
* 0 /usr/lib/jvm/java-6-openjdk/jre/bin/java 1061 auto mode
1 /usr/lib/jvm/java-1.5.0-sun/jre/bin/java 53 manual mode
2 /usr/lib/jvm/java-6-openjdk/jre/bin/java 1061 manual mode
3 /usr/lib/jvm/java-6-sun/jre/bin/java 63 manual mode
Press enter to keep the current choice[*], or type selection number:
Ready
ssh2: AES-256 16, 70 20 Rows, 84 Cols Linux
NUM

### ④ mkimageSetting for Google Android Gingerbreadbuild

Use mkimage and make ramdisk-uboot.img for executable ramdisk on u-boot.
Ramdisk-uboot.img: Combine ramdisk.img and u-boot header.

```
#>cp–a mkimage /bin
```

### ⑤ Google Android GingerbreadCompile

If completeunzip "origen-android.tar.gz" then use below commandand execute compile.
After compile then Android image is created at "out/target/product/smdkc210directory".


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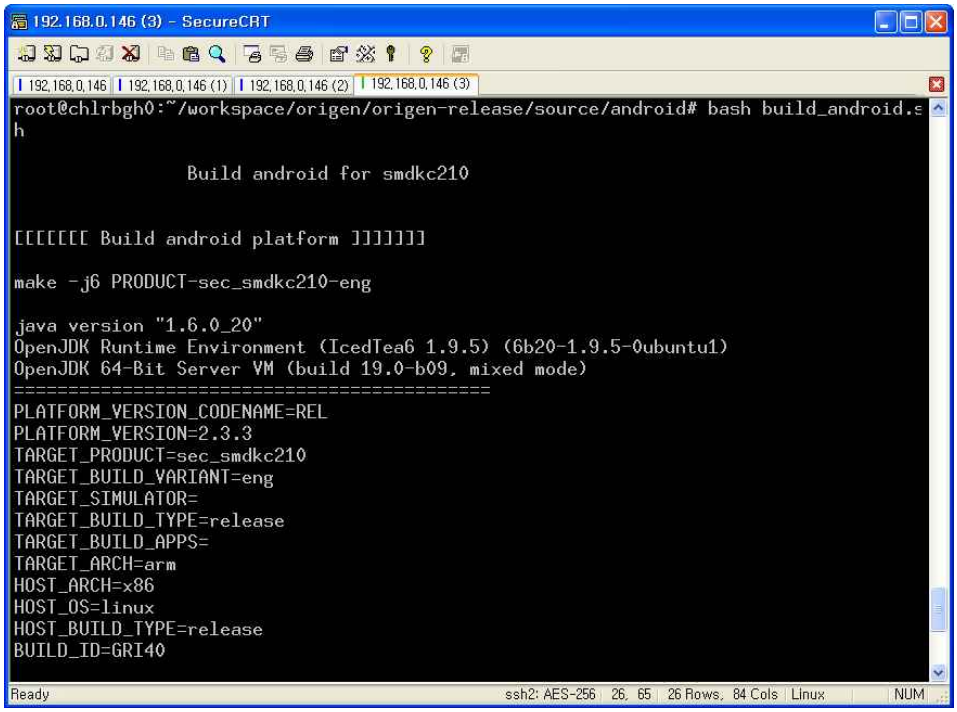
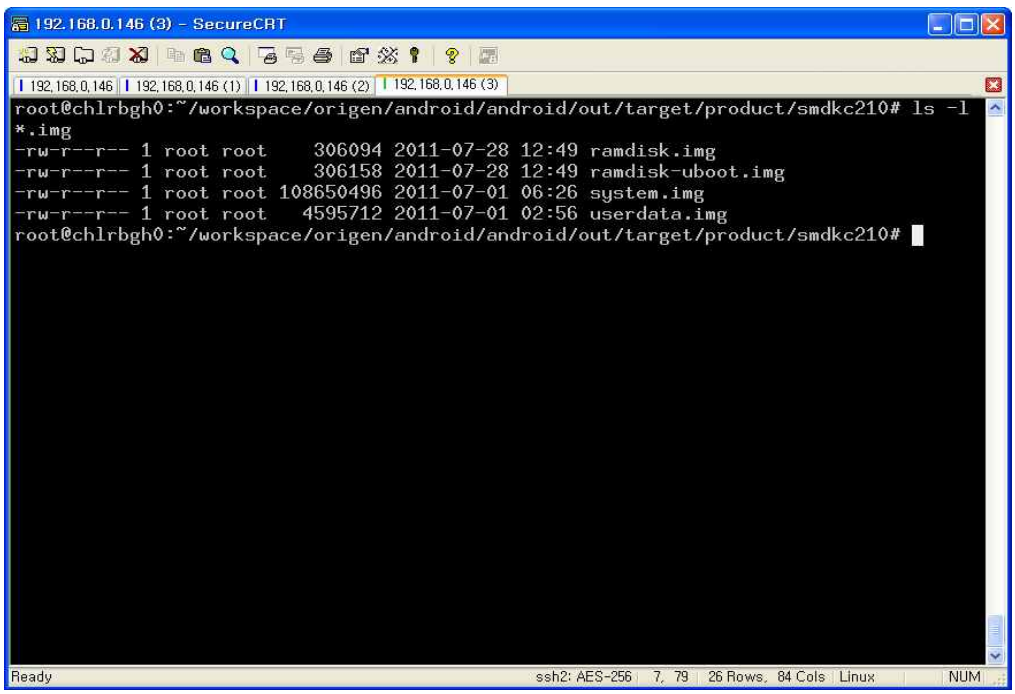



### ⑥ Google Android GingerbreadRootFSbuild

If normally finished build then img files are created at"out/target/product/smdkc210 directory".





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